

IN THE CLAIMS:

1. (Currently Amended) A membrane electrode assembly for use in a direct oxidation fuel cell comprising:

a barrier layer of material that is substantially protonically non-conductive and which is substantially impermeable to water and carbonaceous fuel;

first and second protonically conductive membranes disposed, respectively, on opposite surfaces of said barrier layer;

selected sites comprising openings providing passages through said barrier layer enabling protonically conductive contact through said passages between said first and second membranes, said passages being large enough relative to barrier layer thickness to enable the protonically conductive contact through said barrier layer, while said passages are small enough to substantially prevent the passage of liquid therethrough;

first and second catalysts disposed, respectively, on the surfaces of said membranes which are not in contact with said barrier layer; and

first and second diffusion material layers disposed, respectively, on the surfaces of said catalysts which are not in contact with said membranes.

1 2. (Previously Presented) The assembly as in claim 1 wherein said barrier
2 layer comprises a microporous material.

1 3. (Currently Amended) [[The assembly as in claim 1 wherein]] A membrane elec-
2 trode assembly for use in a direct oxidation fuel cell comprising:

3 a barrier layer of material that is substantially protonically non-conductive and
4 which is substantially impermeable to water and carbonaceous fuel, said barrier layer
5 comprising a polyester microfilm with microperforations[.];

6 first and second protonically conductive membranes disposed, respectively, on
7 opposite surfaces of said barrier layer;

8 selected sites comprising openings providing passages through said barrier layer
9 enabling protonically conductive contact through said passages between said first and
10 second membranes;
11 first and second catalysts disposed, respectively, on the surfaces of said mem-
12 branes which are not in contact with said barrier layer; and
13 first and second diffusion material layers disposed, respectively, on the surfaces
14 of said catalysts which are not in contact with said membranes.

1 4. (Currently Amended) [[The assembly as in claim 1 wherein]]A membrane elec-
2 trode assembly for use in a direct oxidation fuel cell comprising:
3 a barrier layer of material that is substantially protonically non-conductive and
4 which is substantially impermeable to water and carbonaceous fuel, said barrier layer
5 comprising a polyimide film with microperforations;
6 first and second protonically conductive membranes disposed, respectively, on
7 opposite surfaces of said barrier layer;
8 selected sites comprising openings providing passages through said barrier layer
9 enabling protonically conductive contact through said passages between said first and
10 second membranes;
11 first and second catalysts disposed, respectively, on the surfaces of said mem-
12 branes which are not in contact with said barrier layer; and
13 first and second diffusion material layers disposed, respectively, on the surfaces
14 of said catalysts which are not in contact with said membranes said barrier layer com-
15 prises a polyimide film with microperforations.

1 5. (Original) The assembly as in claim 1 wherein said assembly is used in a di-
2 rect methanol fuel cell.

1 6. (Currently Amended) A layered membrane for use in a direct oxidation fuel cell
2 comprising:

3 a barrier layer of material that is substantially protonically non-conductive and
4 which is substantially impermeable to water and carbonaceous fuel; and

5 first and second protonically conductive membranes disposed, respectively, on
6 opposite surfaces of said barrier layer; and

7 selected sites comprising openings providing passages through said barrier layer
8 enabling protonically conductive contact through said passages between said first and
9 second membranes, said passages being large enough relative to barrier layer thickness to
10 enable the protonically conductive contact through said barrier layer, while said passages
11 are small enough to substantially prevent the passage of liquid therethrough.

1 7. (Previously Presented) The membrane as in claim 6 wherein said barrier
2 layer comprises a microporous material.

1 8. (Currently Amended) [[The membrane as in claim 6 wherein]] A layered mem-
2 brane for use in a direct oxidation fuel cell comprising:

3 a barrier layer of material that is substantially protonically non-conductive and
4 which is substantially impermeable to water and carbonaceous fuel, said barrier layer
5 comprising a polyester microfilm with microperforations[[]];

6 first and second protonically conductive membranes disposed, respectively, on
7 opposite surfaces of said barrier layer; and

8 selected sites comprising openings providing passages through said barrier layer
9 enabling protonically conductive contact through said passages between said first and
10 second membranes.

1 9. (Currently Amended) [[The membrane as in claim 6 wherein]] A layered mem-
2 brane for use in a direct oxidation fuel cell comprising:

3 a barrier layer of material that is substantially protonically non-conductive and
4 which is substantially impermeable to water and carbonaceous fuel, said barrier layer
5 comprising a polyimide film with microperforations[[]];

6 first and second protonically conductive membranes disposed, respectively, on
7 opposite surfaces of said barrier layer; and
8 selected sites comprising openings providing passages through said barrier layer
9 enabling protonically conductive contact through said passages between said first and
10 second membranes.

1 10. (Original) The membrane as in claim 6 wherein said membrane is used in a
2 direct methanol fuel cell.

1 11. (Currently Amended) A method of constructing a layered membrane for use in a
2 direct oxidation fuel cell comprising the steps of:
3 providing a layer of material that is substantially protonically non-conductive and
4 which is substantially impermeable to water and carbonaceous fuel; and
5 providing, on opposite sides of said layer, protonically conductive membranes;
6 and providing sites that include passages for protons to pass through said layer
7 which allow protonically conductive contact between said protonically conductive mem-
8 branes, said passages being large enough relative to barrier layer thickness to enable the
9 protonically conductive contact through said barrier layer, while said passages are small
10 enough to substantially prevent the passage of liquid therethrough.

1 12. (Original) The method as in claim 11 wherein said layer comprises a microporous
2 material.

1 13. (Currently Amended) [[The method as in claim 11 wherein]] A method of con-
2 structing a layered membrane for use in a direct oxidation fuel cell comprising the steps
3 of:
4 providing a layer of material that is substantially protonically non-conductive and
5 which is substantially impermeable to water and carbonaceous fuel, wherein said layer
6 comprises a polyester microfilm with microperforations[[]]; and
7 providing, on opposite sides of said layer, protonically conductive membranes;

8 and providing sites that include passages for protons to pass through said layer which al-
9 low protonically conductive contact between said protonically conductive membranes.

1 14. (Currently Amended) [[The method as in claim 11 wherein]] A method of con-
2 structing a layered membrane for use in a direct oxidation fuel cell comprising the steps
3 of:

4 _____ providing a layer of material that is substantially protonically non-conductive and
5 which is substantially impermeable to water and carbonaceous fuel, wherein said layer
6 comprises a polyimide film with microperforations[.]; and

7 _____ providing, on opposite sides of said layer, protonically conductive membranes;
8 and providing sites that include passages for protons to pass through said layer which al-
9 low protonically conductive contact between said protonically conductive membranes.

1 15. (Currently Amended) A method of constructing a membrane electrode assembly
2 for use in a direct oxidation fuel cell comprising the steps of:

3 providing a barrier layer of material which is substantially impermeable to water
4 and carbonaceous fuel and which is substantially impermeable to protons;

5 providing, on opposite sides of said barrier layer, first and second protonically
6 conductive membranes;

7 providing sites in said barrier layer which allow protonically conductive contact
8 between said protonically conductive membranes, said passages being large enough rela-
9 tive to barrier layer thickness to enable the protonically conductive contact through said
10 barrier layer, while said passages are small enough to substantially prevent the passage of
11 liquid therethrough; and

12 providing, on the surfaces of said membranes which are not in contact with said
13 layer, first and second catalyst layers; and

14 providing, on the surfaces of said first and second catalyst layers which are not in
15 contact with said membranes, first and second distribution layers.

1 16. (Previously Presented) The method as in claim 15 wherein said barrier layer com-
2 prises a microporous material.

1 17. (Currently Amended) [[The method as in claim 15 wherein]] A method of con-
2 structing a membrane electrode assembly for use in a direct oxidation fuel cell compris-
3 ing the steps of:
4 _____ providing a barrier layer of material which is substantially impermeable to water
5 and carbonaceous fuel and which is substantially impermeable to protons, said barrier
6 layer comprising a polyester microfilm with microperforations[.];
7 _____ providing, on opposite sides of said barrier layer, first and second protonically
8 conductive membranes; and
9 _____ providing sites in said barrier layer which allow protonically conductive contact
10 between said protonically conductive membranes.

1 18. (Currently Amended) [[The method as in claim 15 wherein]] A method of con-
2 structing a membrane electrode assembly for use in a direct oxidation fuel cell compris-
3 ing the steps of:
4 _____ providing a barrier layer of material which is substantially impermeable to water
5 and carbonaceous fuel and which is substantially impermeable to protons, said barrier
6 layer comprises a polyimide film with microperforations[.];
7 _____ providing, on opposite sides of said barrier layer, first and second protonically
8 conductive membranes; and
9 _____ providing sites in said barrier layer which allow protonically conductive contact
10 between said protonically conductive membranes.

1 19. (Currently Amended) A direction oxidation fuel cell comprising:
2 an anode;
3 a cathode;
4 a membrane electrode assembly, said assembly including a barrier layer of mate-
5 rial that is substantially protonically non-conductive and which is substantially imperme-

6 able to water and fuel, first and second protonically conductive membranes disposed, re-
7 spectively, on opposite surfaces of said barrier layer, said barrier layer having sites in said
8 barrier layer that allow protonically conductive contact between said membranes, said
9 passages being large enough relative to barrier layer thickness to enable the protonically
10 conductive contact through said barrier layer, while said passages are small enough to
11 substantially prevent the passage of liquid therethrough first and second catalysts dis-
12 posed, respectively, on the surfaces of said membranes which are not in contact with said
13 layer, and first and second diffusion material layers disposed, respectively, on the sur-
14 faces of said catalysts which are not in contact with said membranes; and
15 a housing in which said anode, cathode and assembly are disposed.

1 20. (Previously Presented) The fuel cell as in claim 19 wherein said barrier layer
2 comprises a microporous material.

1 21. (Currently Amended) [[The fuel cell as in claim 19 wherein]] A direction oxida-
2 tion fuel cell comprising:
3 an anode;
4 a cathode;
5 a membrane electrode assembly, said assembly including a barrier layer of mate-
6 rial that is substantially protonically non-conductive and which is substantially imperme-
7 able to water and fuel, said barrier layer comprising a polyester microfilm with microper-
8 forations[[]], first and second protonically conductive membranes disposed, respectively,
9 on opposite surfaces of said barrier layer, said barrier layer having sites in said barrier
10 layer that allow protonically conductive contact between said membranes, said passages
11 being large enough relative to barrier layer thickness to enable the protonically conduc-
12 tive contact through said barrier layer, while said passages are small enough to substan-
13 tially prevent the passage of liquid therethrough first and second catalysts disposed, re-
14 spectively, on the surfaces of said membranes which are not in contact with said layer,
15 and first and second diffusion material layers disposed, respectively, on the surfaces of
16 said catalysts which are not in contact with said membranes; and

17 a housing in which said anode, cathode and assembly are disposed.

1 22. (Currently Amended) [[The fuel cell as in claim 19 wherein]] A direction oxida-
2 tion fuel cell comprising:

3 an anode;

4 a cathode;

5 a membrane electrode assembly, said assembly including a barrier layer of mate-
6 rial that is substantially protonically non-conductive and which is substantially imperme-
7 able to water and fuel, said barrier layer comprises a polyimide film with microperfora-
8 tions[.], first and second protonically conductive membranes disposed, respectively, on
9 opposite surfaces of said barrier layer, said barrier layer having sites in said barrier layer
10 that allow protonically conductive contact between said membranes, said passages being
11 large enough relative to barrier layer thickness to enable the protonically conductive con-
12 tact through said barrier layer, while said passages are small enough to substantially pre-
13 vent the passage of liquid therethrough, first and second catalysts disposed, respectively,
14 on the surfaces of said membranes which are not in contact with said layer, and first and
15 second diffusion material layers disposed, respectively, on the surfaces of said catalysts
16 which are not in contact with said membranes; and

17 a housing in which said anode, cathode and assembly are disposed.

1 23. (Currently Amended) The fuel cell as in [[claim 19]] claim 22 wherein
2 said fuel cell is a direct methanol fuel cell.